

REMARKS

This is a full and timely Response to the non-final Office action of February 7, 2001. For this response, claims 1, 4-11, and 14-18 remain pending in the application. Claims 2, 3, 12, 13, 19 and 20 were previously cancelled. The Office Action rejects claims 1, 4-11 and 14-18 under 35 U.S.C. § 103(a). The Applicant respectfully requests reconsideration.

Rejections Under 35 U.S.C. §103

The Office Action rejects claims 1, 4-7, 9-11, 14-18 under 35 U.S.C. § 103(a) as being unpatentable over Greene et al (5,579,455), (hereinafter referred to as "*Greene*"), in view of Sudarsky et al (6,088,035), (hereinafter referred to as "*Sudarsky*"). With respect to claims 1, 11 and 18, which are the independent claims in the present application, the Office Action states that *Greene* discloses

"the logic comparing the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded (col. 26, lines 61-67); if the tested primitive is not fully occluded, the logic determine whether or not any subregion of the region associated with the tested primitive is fully covered by the primitive, wherein if a subregion is fully covered by the tested primitive, then the logic determines whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive (col. 19, lines 44-49, fig. 12); the logic to determine whether the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive, the logic determines whether the maximum Z value of the tested primitive is less than the Z value (nearer than the current depth value) for the covered subregion, if the maximum Z value is less than the Z value for the covered subregion, then the Z value for the covered subregion is replaced with the maximum Z value (col. 19, lines 50-53); further, Sudarsky discloses updating the potentially visible dynamic object list as previously hidden dynamic objects becomes visible and hidden. It would have been obvious to one of ordinary skill in the art to incorporate the Sudarsky's teaching into Greene's method for updating the occluded dynamic object during the time period (on the fly), providing an improved method for displaying graphics models which adapts visibility culling algorithms to dynamic scenes, and also minimizes the update overhead of the model that may be potentially visible to the user."

The Applicant respectfully disagrees. Neither *Greene* nor *Sudarsky* discloses, teaches or suggests, either along or in combination, determining whether the tested primitive is not fully occluded and if not, replacing the Z value for the subregion with the maximum Z value of the primitive, as recited in independent claims 1, 11 and 18. *Greene* does not disclose or teach these limitations because the approach of *Greene* does not make any provision for updating the Z pyramid "on the fly", i.e., as primitives are being processed through the graphics pipeline, which is what the aforementioned language of claims 1, 11 and 18 describes. Once a determination is made that a cube contains a visible primitive, the visible primitive must be scan converted to the pixel level before the Z buffer can be updated and the Z pyramid can be reconstructed. (See *Greene*, Col. 18, line 62 -Col. 19, line 20). All of the algorithms described in *Greene et al.* require that each face of each cube be scan converted in order to determine whether or not the cube is hidden. Therefore, the algorithms inherently require that scan conversion be performed before the Z pyramid can be updated.

In contrast, the present invention enables the Z buffer to be updated and the Z pyramid to be reconstructed on the fly as primitives are processed prior to scan conversion. In accordance with the present invention, as described in independent claims 1, 11 and 18, each region corresponds to a plurality of Z values and has a maximum region Z value which corresponds to the largest Z value of the region. The minimum Z value of each primitive is compared with the Z value of a region associated with the primitive to determine whether or not the primitive is fully occluded. If a determination is made that the primitive is not fully occluded, then a determination is made as to whether or not any subregion of the region associated with the primitive is fully covered by the primitive. If a determination is made that a subregion is fully covered by the primitive, then the logic determines whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive. If so, the Z pyramid is updated accordingly. Thus, the Z pyramid is updated on the fly, rather than waiting until primitives have been scan converted. This, in turn, expedites the Z comparison tests and improves the overall performance of the computer graphics display system.

Furthermore, *Sudarsky* does not disclose or teach the above-mentioned language in claims 1, 11, and 18 because it is not related to the field of updating a hierarchical Z buffer in a graphics system of a computer graphics display system. Rather, it discloses a visibility algorithm that does not update a hierarchical Z buffer (Col. 2, line 64 – Col. 3, line 2; Col. 3, line 44 – Col. 4, line 12; Col. 4, line 61 – Col. 5, line 13).

Since all of the independent claims in the present application include these features of the present invention, the Applicant respectfully requests that the rejection of the independent claims, namely, claims 1, 11 and 18, be withdrawn. Since all of the remaining claims depend either directly or indirectly from one of these independent claims, the Applicant respectfully requests that the rejections to the dependent claims also be withdrawn.



CONCLUSION

In view of all the foregoing, the Applicant respectfully submits that claims 1, 4-11, 14-18 are in condition for allowance and such action by the Examiner is earnestly solicited.

Respectfully submitted,

Scott A. Horstemeyer
Registration No. 34,183

**THOMAS, KAYDEN, HORSTEMEYER
and RISLEY, L.L.P.**

Suite 1750
100 Galleria Parkway N.W.
Atlanta, Georgia 30339
(770) 933-9500